OCCUPATIONAL EXPOSURES TO MEVINPHOS (PHOSDRIN) REPORTED BY PHYSICIANS IN CALIFORNIA DURING 1980

by

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SUMMARY

In 1980, there were 48 exposures to mevinphos reported by physicians to the California Department of Food and Agriculture. All these exposures were suspected systemic illnesses. Although the number of illnesses from exposure to mevinphos reported in 1980 (48 cases) was 60 percent higher than the number of illnesses reported in 1979 (30 cases), the increase was not significant ($p < 0.05$) when the expected number of illnesses was adjusted in proportion to the increased use (33 percent) of mevinphos in 1980 compared to 1979. With the exception of a single episode involving 21 field workers exposed to mevinphos residue, the majority of the 1980 illnesses were in occupations which require the handling of mevinphos concentrates. Most illnesses occurred during the summer. This is the most toxic organophosphate in common use in California, and is responsible for a significant number of user illnesses each year. Constant attention by both employers and employees is necessary to avoid excessive exposure to this pesticide.

INTRODUCTION

There were 509,713 pounds of the organosphosphate mevinphos and related compounds used during 1980 in California. The pesticide is highly toxic with an acute oral LD_{50} (rat) of approximately 3.7-12.0 mg/kg, and an acute dermal LD_{50} (rabbit) of approximately 16.0-33.8 mg/kg. Ingestion, inhalation, or dermal contact with mevinphos can result in serious acute systemic illness.

CASE STUDIES

Systemic Illnesses

There were 48 cases of suspected systemic illness involving mevinphos reported by physicians in California in 1980. These incidents received follow-up field investigations by staff members of the county agricultural commissioners.

A worker mixing and loading mevinphos for a ground application unknowingly contaminated his boots while filling a ground rig from a mix tank. After he got into a nearby pickup truck cab to warm himself, the worker could smell mevinphos as the heater in the pickup was running. The following day, the worker was using the same mixing system and, although he was not mixing mevinphos, he could still smell it. A short time later, he developed a headache and lay down. The following day, as he arose for work, he was dizzy and perspiring. He returned to bed. Later the same day, his brother took him to a hospital. Signs and symptoms were headache, nausea, vomiting, chills, blurred vision, and tremors, and he was in the hospital 3 days for phosdrin poisoning.

The employer of the former worker experienced weakness and nausea as he joined his employee in the same pickup cab to warm himself. He went to a physician for blood cholinesterase determinations and medical attention. He was not hospitalized.

A worker was cleaning a ground rig, previously used for a mevinphos application, when some of the material in the spray rig leaked through the sleeve of his coveralls and onto his forearm. He washed the coverall sleeve and his forearm, and he continued working. Later, he experienced headache, dizziness, and vision difficulty. He was taken to a physician and his illness was diagnosed as organophosphate poisoning. He was treated, released, and told to visit the doctor later that day. When the worker visited the doctor in his office the next day, the doctor discovered that the worker was still wearing the same coveralls, and his symptoms had progressed. He was taken to a hospital and admitted to the intensive care unit. He was treated and remained in the hospital 3 days. He lost 20 days of work.

A worker mixing and loading mevinphos for an aerial application was exposed to the pesticide while he was moving mevinphos containers from an unlighted storage area. One of the containers had mevinphos on the lid, and the

worker got his hands in the concentrate as he moved the container. He washed his hands and continued working. Later, he was taken to a hospital complaining of dizziness, headache, nausea, and blurred vision. He was treated with atropine and admitted to the hospital. The worker remained in the hospital 2 days; he lost 60 work days.

A worker was applying mevinphos with a ground rig during a windless night; he was not wearing a respirator. The crop rows were short and he crossed his own drift repeatedly. When he noticed eye irritation, he stopped work and was taken to a hospital. His blood cholinesterase levels were severely depressed from his baseline values. Organophosphate poisoning was diagnosed. He was admitted to the hospital and treated with atropine and Protopam Chloride. He remained in the hospital 2 days; he lost 7 days' work.

A worker was hand-pouring mevinphos at night for a ground application. His only light source throughout the activity was a flashlight, and he stated that some of the material may have spilled on his hands or coveralls. Later that evening, he was taken to the hospital with symptoms including vomiting, dizziness, and blurred vision. The worker was admitted to the intensive care unit, and the diagnosed organophosphate poisoning was treated with atropine and Protopam Chloride. He remained in the hospital 2 days and lost 7 days of work. The worker did not feel completely normal for 2 weeks, and occasional dizziness remains. He revisited the doctor 3 times the following month for blood cholinesterase determinations.

After mixing and loading mevinphos for 15 hours, an employee of an aerial application firm became ill. He was not aware of a particular incident which could have caused the exposure. Although he was wearing all the required protective equipment, he began to smell mevinphos through his respirator. His first symptoms were chills and shaking. Later he suffered dizziness, shortness of breath, hot and cold flashes, nausea, vomiting, and excessive perspiration. He was taken to a hospital where the illness was diagnosed as possible insecticide poisoning. He was treated with atropine, put on an I.V., and supplied oxygen. He was hospitalized for 2 days, and he lost 7 days' work.

An employee mixing and loading mevinphos for an aerial application became ill after bandages on his hand became saturated with the mixture. He was uncertain about the time and circumstances of his exposure. He was taken to a hospital, and a doctor diagnosed the illness as organophosphate poisoning. He was treated with 2 injections of atropine and 1 injection of Protopam Chloride. He remained in the hospital 2 days, and he lost 5 days of work. One week passed before he felt completely normal. The worker visited the doctor twice during the next 2 months for blood cholinesterase determinations.

A worker applying mevinphos with a ground rig was sprayed in the face and on the arm when a valve on the spray rig ruptured as the pressure in the system got too high. He immediately removed his clothes and showered. He was taken to a hospital complaining of headache, stomach cramps, and nausea. The illness was diagnosed as organophosphate poisoning, and the worker was treated with atropine. He remained in the hospital 2 days and lost 4 days' work. The worker revisited the doctor 4 days later for a checkup. He felt completely normal 8 days after the incident. Several months later, the worker was still complaining of occasional chest pain, chronic weakness, and excessive arm perspiration.

Twenty-one field workers banding cauliflower before the 3-day reentry interval had expired were exposed to mevinphos and phosphamidon residue. They suffered various symptoms ranging from mild headaches to nausea, dizziness, and blurred vision. All the workers were taken to a hospital emergency room; 15 to one hospital and 6 to another. Thirteen of the group of 15 were treated and released; the other 2 were treated and remained in the hospital for less than 24 hours. Of the 6 workers taken to the other hospital, 3 were treated and hospitalized for more than 24 hours, and the other 3 were treated and released. Total hospitalization for the 21 workers was 3 days, and the total workdays reported lost was 6.

While applying mevinphos with a ground rig, a worker accidentally hit a pole with the end of the spray boom. When he inspected the damage to the equipment, a break in the boom allowed the material to spray his left leg. He immediately washed the exposed area and changed his clothes. He was taken to a physician complaining of an upset stomach, nausea, and dizziness. He received treatment but was not hospitalized. He lost 28 days' work.

A worker in a manufacturing and formulation plant was filling 2-gallon containers with mevinphos when he began experiencing head and body aches. He was taken to a physician who diagnosed the illness as organophosphate poisoning, and treated it. He was not hospitalized although he lost 10 days' work. He revisited the doctor 3 times for blood cholinesterase determinations. The worker felt completely normal 3 weeks after his exposure to mevinphos.

A worker applying mevinphos with a ground rig checked the level of the mixture in the spray tank and accidentally splashed some material on his back. He did not bathe or change his clothing. Later, he became ill and went to a physician; diagnosis and treatment were not reported. The worker was not hospitalized, but he lost 3 days' work.

A mixer/loader was inserting a probe into a 2-gallon can of mevinphos for an aerial application. The can was slightly pressurized, and a fine mist sprayed him on the chin. He washed immediately and continued his work. Approximately 2 hours later, he experienced nausea and went to the hospital. A physician examined him and found no additional symptoms; he prescribed no treatment. The worker was held for observation and released later that day. He lost 2 days' work. Two days passed before he felt completely normal. The worker revisited the doctor 5 days later for a checkup.

A worker weeding a field the day after it was sprayed with mevinphos became ill at mid-day. He suffered nausea and vomiting. He went to a hospital and a physician diagnosed the illness as organophosphate poisoning. Atropine was administered, and the worker was observed for 12 hours. One day of work was lost.

A foreman for a chemical company was exposed to mevinphos when a mix tank containing the material overflowed because of a malfunctioning water valve. He washed himself immediately and was taken to a hospital. The headache, stomach cramps, and nausea he experienced were diagnosed as organophosphate poisoning. He was treated with atropine and released. He lost 1 day of work.

An employee of a pesticide manufacturing and formulating plant became ill after working with mevinphos. He experienced dizziness, nausea, and vomiting. He was taken to a physician for care. The employee was not hospitalized, and he felt completely normal 4 days after the exposure. The worker revisited the doctor 3 days later for a blood test; he had no residual symptoms. He lost 1 day of work.

A worker was observing the mixing and loading of mevinphos for an aerial application when a hose broke, and the pesticide solution splashed on him. He removed his clothes and washed immediately. Later, he was taken to a hospital as he was suffering from nausea and vomiting. A physician diagnosed organophosphate poisoning and administered atropine; he was not hospitalized. He lost 1 day of work, and felt completely normal 2 days after the incident. The worker did not revisit a doctor, and he had no residual symptoms.

A worker mixing and loading mevinphos for an aerial application became ill after work. He experienced nausea, excessive perspiration, and blurred vision. His mother took him to the hospital where he was treated with atropine and Protopam Chloride. He was not hospitalized. After the incident, he found work elsewhere; he had no residual symptoms.

A worker applied mevinphos with a ground rig, and he became ill after he walked through the treated field. He was wearing a respirator, but later it was discovered that the inhalation valve flap in the respirator was missing. He developed nausea, dizziness, and blurred vision, and his pupils were constricted. The worker was taken to a hospital where a physician diagnosed the illness as pesticide intoxication. He was treated with atropine. He was not hospitalized, and he lost no workdays. Several months later, he was still complaining of occasional headaches, but he was uncertain if the headaches were a result of this incident.

A worker was applying mevinphos to lettuce with a ground rig. After 5 hours' work, he began feeling dizzy, and he was taken to a physician. No symptoms were apparent during the doctor's examination, although the dizziness which the worker experienced was attributed to the pesticide. He lost no work days.

A ground applicator exhibited a lowered cholinesterase level when he was giving blood for a routine cholinesterase test. He had been applying mevinphos prior to that day. He complained of no symptoms and he received no treatment. A physician asked the worker to modify his work for 2 weeks by not working with cholinesterase inhibitors. The worker lost no work days. He did not return to the doctor for follow-up care since he had no residual symptoms.

While unjamming a valve on an aerial application rig, an employee's face and right arm were spattered with dilute mevinphos. He washed immediately and was taken to a hospital, as he was complaining of dizziness. A physician found no symptoms; he prescribed a shower. The worker was not hospitalized and he lost no work time.

An employee was removing a can of mevinphos from a closed mixing system after the can was rinsed with water, when some of the rinse water splashed onto his leg. Later, he began feeling weak and was taken to a hospital. The physician reported no symptoms. The employee was not hospitalized and he lost no work time.

An employee working for an aerial applicator became ill with symptoms of nausea, dizziness, tremors, weak knees, and blurred vision. His most recent work included mixing and loading mevinphos. He could not recall a particular incident which might have exposed him to the pesticide. He was taken to a hospital emergency room where he was treated and released. No time was lost from work.

A flagger for an aerial application of mevinphos removed his coveralls and lay down to rest in the field which had just been sprayed with the pesticide. He began feeling ill later that day, and was taken to a physician for care. The employee was not hospitalized and he lost no workdays.

A worker mixing and loading mevinphos and other pesticides for aerial applications complained of excessive perspiration, salivation, and stomach cramps. He had been working long hours with the pesticides for the previous 3 days. He was taken to a physician who diagnosed the illness as a possible organophosphate poisoning. The doctor prescribed rest and released him. The worker lost no workdays.

While a worker was loading a mevinphos mixture for an aerial application, a hose gasket blew out, and the worker thought he had been exposed to the mixture. He changed his coveralls and washed thoroughly. Later, he developed a headache and went to a physician, who found no additional symptoms and prescribed no treatment. The worker lost no workdays.

DISCUSSION

Mevinphos is a highly toxic organophosphate insecticide, and human exposure to small quantities of the pesticide can result in serious acute illness. Mevinphos is formulated and sold as either an emulsifiable concentrate and a water soluble liquid. Consequently, this toxicity category one pesticide requires a closed system during mixing and loading operations prior to application.

The symptoms of an illness due to mevinphos exposure are the same as those observed with all organophophate poisonings. The symptoms (e.g., pinpoint pupils, headache, nausea, and perspiration) are elicited by the reduced function of acetyl-cholinesterase. These systemic effects are reflected by the total number of systemic illnesses which occurred during the past 5 years (Table 1). Ninety-four percent of all reported occupational illnesses due to mevinphos during 1976 through 1980 were systemic. All 48 of the 1980 mevinphos illnesses were systemic.

The increase from 30 illnesses in 1979 to 48 illnesses in 1980 is significantly higher at the 95 percent confidence level (Chi-square test) when assuming that the number of illnesses in the 2 years should be equal. However, there was a 33 percent increase in the reported number of pounds of mevinphos used in 1980 (509,713) compared to 1979 (383,385). When this increased use of mevinphos in 1980 is reflected in the number of expected 1980 illnesses, there is no significant difference (Chi-square test) between the number of mevinphos illnesses observed in 1980 compared to 1979.

Occupations which include the handling of the undiluted formulations of mevinphos are more liable to result in pesticide-related illnesses, as a single exposure to the concentrate may be sufficient to produce an illness. This is reflected in Table 1. Sixty-three percent of the total number of reported illnesses due to mevinphos during the past 5 years affected mixer/loaders, manufacturing/formulators, and ground applicators (Table 1). In 1980, only 42 percent of the mevinphos illnesses involved these same occupations. A single episode involving 21 field workers exposed to mevinphos residue accounted for 44 percent of the 1980 illnesses. Cluster illnesses of this type have not occurred in the previous 4 years, and if this incident is excluded, the illnesses of mixer/loaders, manufacturing/formulators, and ground applicators would account for 74 percent of the 1980 illnesses.

The days of hospitalization and disability resulting from the mevinphos illnesses during the past 5 years are summarized in Tables 2 and 3. During 1976, 1977, and 1978, the days of hospitalization and disability were estimated by the physicians who saw the workers during their initial visits. The actual days of hospitalization and disability during 1979 and 1980 were refined by additional follow-up telephone calls to those workers who could be easily located. However, the number of affected persons which could be contacted during these follow-up investigations varied between 1979 and 1980. Consequently, the hospitalization and disability resulting from 1980 exposures cannot be compared exactly to the previous 4 years.

In addition to the data available from the medical report and from the field investigation reports by the staff members of the agricultural commissioners, a telephone follow-up was conducted in April 1981 that reached 11 of the 49 persons who were reported poisoned in 1980. This was done to compare anticipated time lost from work with the actual time lost, and to inquire as to the existence of any residual symptoms. Of these 11, residual symptoms were reported as follows: occasional dizziness, 1 case; localized perspiration, 1; occasional headaches, 1; and general fatigue, 1.

The seasonal occurrence of mevinphos illnesses is portrayed in Table 4. The majority of illnesses during the last 5 years occurred in late spring through early fall. Although more mevinphos is used during the warmer months, the increase in illnesses is not proportional to the pounds of mevinphos applied. Additional factors which may increase the incidence of mevinphos illnesses during this time of the year are (1) greater volatility of mevinphos at higher temperatures, (2) greater dermal absorption rates with higher ambient temperatures, and (3) the desire to wear less protective equipment and clothing when the weather is hot.

Table 5 summarizes by county the distribution of mevinphos illnesses which occurred in the past 5 years. All of the 1980 illnesses occurred in 11 of the 58 counties.

TABLE 1

ILLNESSES DUE TO PHOSDRIN EXPOSURE TO MEVINPHOS
REPORTED BY TYPE OF ILLNESS AND JOB CATEGORY
FOR 1976 THROUGH 1980 IN CALIFORNIA

	1976	1977	1978	1979	1980	Total
Suspected Systemic Illnesses	58	48	37	29	48	220
Mixer/Loader	22	32	18	12	11	95
Manufacturing/Formulating	8	1	3	3	2	17
Ground Applicator	12	6	2	7	7	34
Flagger	4	2	4	0	1	11
Field Worker	4	0	1	0	22	27
Aerial Applicator	1	1	0	0	0	2
Worker Exposed to Drift	1	0	1	0	0	2
Truck Loader/Warehouse	0	2	2	2	0	6
Cleaner/Repairer	1	3	1	1	1	7
Indoor Worker	1	0	0	0	0	1
Other Type Pesticide Exposure	2	1	3	0	3	9
Exposed, Not Ill	0	0	2	0	0	2
Unconfirmed Report	2	0	0	0	0	2
Self Employed (Farmer)	0	0	0	4	1	5
Skin Exposure Incidents	6	1	0	0	0	7
Irrigator	0	0	0	0	0	0
Field Worker	3	1	0	0	0	4
Mixer/Loader	1	0	0	0	0	1
Manufacturing/Formulating	1	0	0	0	0	1
Exposed, Not Ill	1	0	0	0	0	1
Eye Exposure Incidents	3	0	1	1	0	5
Cleaner/Repairer	0	0	0	0	0	0
Field Worker	1	0	0	0	0	1
Mixer/Loader	2	0	0	0	0	2
Manufacturing/Formulating	0	0	1	0	0	1
Ground Applicator	0	0	0	1	0	1
Skin and Eye Incidents	0	0	1	0	0	1
Manufacturing/Formulating	0	0	1	0	0	1
Total Illnesses to Phosdrin Exposure	67	49	39	30	48	233

TABLE 2

ILLNESSES DUE TO PHOSDRIN EXPOSURE TO MEVINPHOS
REPORTED BY DAYS OF HOSPITALIZATION AND DISABILITY
FOR 1976 THROUGH 1980 IN CALIFORNIA

Hospitalization	1976*	1977*	1978*	1979	1980
None	48	37	22	8	37
1 Day	4	5	5	8	3
2 Days	8	1	6	3	6
3 Days	3	5	1	3	2
4-5 Days	2	0	2	3	0
6 Days	0	1	0	0	0
7 Days	0	0	0	1	0
Unspecified	2	3	3	4	0
Period of Disability*					
None	10	5	9	6	9
1 Day	5	3	0	3	4
2 Days	9	3	2	2	1
3-4 Days	6	6	2	7	4
5-7 Days	6	7	3	4	4
8-14 Days	3	5	1	0	1
3-4 Weeks	3	4	5	1	2
More Than 4 Weeks	3	0	1	1	1
Unspecified	22	19	16	6	21

*Period of disability is the period of time that the worker is estimated by the physician to be off work, and it includes the days hospitalized. The estimation is made at the time of the worker's initial visit to the physician.

TABLE 3

ILLNESSES DUE TO MEVINPHOS EXPOSURE
REPORTED BY TOTAL ESTIMATED DAYS OF HOSPITALIZATION
AND DISABILITY FOR 1976 THROUGH 1980 IN CALIFORNIA

Total Estimated Days of Hospitalization

1976	1977	1978	1979**	1980**
44	37	38	42	21

Total Estimated Days of Disability**

1976	1977	1978	1979**	1980**
579	491	422	131	163

**In 1979 and 1980, investigators more accurately determined the actual days of disability and hospitalization incurred by the worker.

TABLE 4

ILLNESSES DUE TO EXPOSURE TO MEVINPHOS
REPORTED BY MONTH OF OCCURRENCE
FOR 1976 THROUGH 1980 IN CALIFORNIA

Month	1976	1977	1978	1979	1980	Total
January	1	3	1	0	0	5
February	5	0	2	0	1	8
March	6	4	1	0	1	12
April	4	6	2	0	2	14
May	3	2	2	2	2	11
June	4	4	5	5	2	20
July	13	5	15	3	25	61
August	8	8	4	7	6	33
September	11	5	4	5	3	28
October	3	9	3	5	6	26
November	8	3	0	3	0	14
December	1	0	0	0	0	1
Total	67	49	39	30	48	233

TABLE 5

ILLNESSES DUE TO EXPOSURE TO MEVINPHOS
REPORTED BY COUNTY OF OCCURRENCE
FOR 1976 THROUGH 1980 IN CALIFORNIA

County	1976	1977	1978	1979	1980	Total
Alameda	0	1	0	0	0	1
Fresno	7	2	5	4	8	26
Imperial	8	8	5	2	1	24
Kern	12	3	9	3	4	31
Kings	2	1	0	0	1	4
Los Angeles	3	2	0	3	0	8
Madera	1	0	0	0	0	1
Merced	1	8	1	0	0	10
Monterey	9	8	8	5	27	57
Orange	3	3	0	0	0	6
Riverside	3	5	0	0	1	9
San Benito	1	1	0	1	1	4
San Bernardino	0	1	0	1	0	2
San Joaquin	1	0	1	1	1	4
San Luis Obispo	1	0	1	0	0	2
Santa Barbara	3	1	0	0	2	6
Santa Clara	0	0	0	6	0	6
Santa Cruz	7	1	4	2	0	14
Tulare	2	0	6	2	0	10
Ventura	1	1	0	0	1	3
Yolo	2	2	0	0	1	5
Total	67	49	39	30	48	233